



## Subject card

Subject name and code	, PG_00056135						
Field of study	Mechatronics						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2024/2025		
Education level	first-cycle studies	Subject group					
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	3	Language of instruction			Polish		
Semester of study	6	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Szymon Grymek				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	30		0.0		0.0	30
Subject objectives	Understanding the basics of optimization and polyoptimization as applied to design and control in robotics.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W10] has a basic knowledge about development trends in terms of engineering and technical sciences and scientific disciplines: Mechanical Engineering, Automation, Electronics and Electrical Engineering, adequate for Mechatronics course	Student knows the ways of using artificial intelligence methods in optimization.			[SW1] Assessment of factual knowledge		
	[K6_U06] is able to identify and formulate specification of simple, practical engineering tasks, distinctive for mechatronics	Student is able to define a robotics-specific optimization task.			[SU1] Assessment of task fulfilment		
	[K6_W08] knows and understands design and production processes of elements and simple mechatronic devices	Student knows the methods of applying optimization in the design of mechatronic devices.			[SW1] Assessment of factual knowledge		
	[K6_U05] is able to use properly choosen tools to compare design solutions of elements and mechatronics systems according to given application and economic criterions (e.g. power demand, speed, costs)	Student is able to choose the methods and means necessary for the effective solution of the given optimization task.			[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment		
[K6_W11] has a basic knowledge about the life cycle of mechatronic systems and objects	Student knows the evaluation criteria used in the design of mechatronic systems.			[SW1] Assessment of factual knowledge			

Subject contents	<p><b>LECTURE</b>  Optimization and selection. Criteria and decision variables. Polyoptimization. Criteria weights. Utility function. Objective function. Inequality, equality and cube constraints. Linear and nonlinear programming. Gradient and non-gradient methods of minimizing the objective function. Artificial neural networks in optimization. Evolutionary algorithms in optimization.</p> <p><b>LABORATORY</b>  Demonstration of defining and solving the selection task.  Demonstration of the definition and solution of the poly-optimization task.  Demonstration of the use of artificial neural networks in optimization.  Demonstration of the use of an evolutionary algorithm in optimization.  Student independently defines and solves the task of poly-optimization.</p>											
Prerequisites and co-requisites	Basics of matrix and differential calculus. Fundamentals of mechanics, robotics, automation, strength of materials and thermodynamics. Basic knowledge of Matlab / Octave / Scilab.											
Assessment methods and criteria	<table border="1" data-bbox="448 710 1498 815"> <thead> <tr> <th data-bbox="448 710 794 741">Subject passing criteria</th> <th data-bbox="794 710 1141 741">Passing threshold</th> <th data-bbox="1141 710 1498 741">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 741 794 772">Colloquium</td> <td data-bbox="794 741 1141 772">50.0%</td> <td data-bbox="1141 741 1498 772">60.0%</td> </tr> <tr> <td data-bbox="448 772 794 815">Task of poly-optimization</td> <td data-bbox="794 772 1141 815">50.0%</td> <td data-bbox="1141 772 1498 815">40.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Colloquium	50.0%	60.0%	Task of poly-optimization	50.0%	40.0%
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Colloquium	50.0%	60.0%										
Task of poly-optimization	50.0%	40.0%										
Recommended reading	Basic literature	Tarnowski W.: optymalizacja i polioptymalizacja w mechatronice. Wydawnictwo Uczelniane Politechniki Koszalińskiej, 2009 Findeisen W., Szymanowski J., Wierzbicki A.: Teoria i metody obliczeniowe optymalizacji. PWN Warszawa 1972 Hertz J., Krogh A., Palmer R.G.: Wstęp do obliczeń neuronowych. WNT Warszawa 1993 Goldberg D.E.: Algorytmy genetyczne i ich zastosowania.										
	Supplementary literature	Osiński Z., Wróbel j.: Teoria konstrukcji maszyn. Seria PKM. PWN Warszawa 1992 Tarnowski W.: Podstawy projektowania technicznego. WNT Warszawa 1997 Milkiewicz F.: Podstawy optymalizacji. Skrypt PG. Gdańsk 1995 Fortuna Z., Macukow B., Wąsowski J.: Metody numeryczne. WNT Warszawa 1982 Pająk E., Wieczorowski K.: Podstawy optymalizacji operacji technologicznych w przykładach. PWN Warszawa 1982										
	eResources addresses	Adresy na platformie eNauczanie:										
Example issues/ example questions/ tasks being completed	Find the fastest route from point A to point B through 3 centers of different traffic resistance. Determine the design features of a bending spring minimizing material consumption.											
Work placement	Not applicable											